Astrophysics Research And Analysis

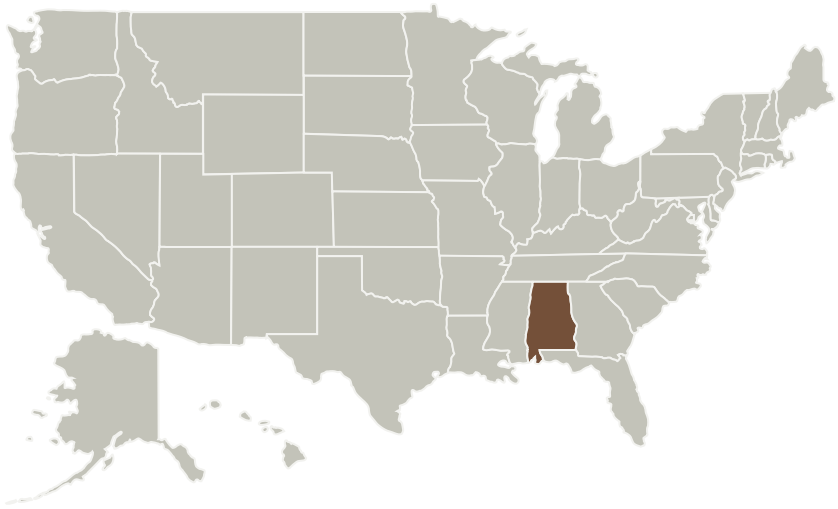
A resolution to the low temperature electron recombination problem for astrophysical plasmas.

Completed Technology Project (2015 - 2018)

Project Introduction

Recent and ongoing work on electron recombination of atomic systems has revealed a range of ions where rates are underestimated or overestimated, sometimes by an order of magnitude, due to the positioning of resonance(s) near to the ground state threshold. Consequently, these ion stages may have a significant effect on diagnostics of abundances, temperatures, and densities. We propose to (1) implement a new type of survey calculation to identify which ions exhibit sensitivity to near threshold resonances; (2) quantify the resulting uncertainties in the DR rates for these ion stages; (3) show that the recently proposed process of "below threshold DR" can provide accurate rate coefficients for ions with critical sensitivity to near threshold resonances, and (4) archive and release these rates for use in astrophysical spectral studies. To achieve these results we will use a range of methods to calculate electron recombination, including both semi- and fully-relativistic approaches. The new theory for the inclusion of below threshold recombination was recently derived in the literature and will be used in this proposal. The work would be of significance for a range of NASA objectives and missions. These would include the analysis of low temperature photo-ionized plasmas. It would determine the atomic systems for which the low temperature recombination rate coefficients can be used with confidence, and provides a means to remove the sensitivity of the remaining rate coefficients to their near threshold resonances. As such it would lead to an improved understanding of these plasmas and their role in the cosmos.

Primary U.S. Work Locations and Key Partners



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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Astrophysics Research and Analysis

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Organizations Performing Work	Role	Type	Location
Auburn University	Supporting Organization	Academia	Auburn, Alabama

Primary U.S. Work Locations
Alabama

Project Management

Program Director:
Michael A Garcia

Program Manager:
Dominic J Benford

Principal Investigator:
Stuart D Loch

Co-Investigators:
Michael S Pindzola
John M Mason

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.3 In-Situ Instruments and Sensors
    - TX08.3.1 Field and Particle Detectors

Target Destination

Outside the Solar System